* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the input unit in which the three-dimension input for moving the cursor on the screen in a personal computer etc. is possible.
[0002]
[Description of the Prior Art] There are a trackball and a mouse as an input device (a pointing device is called hereafter) to indicating equipments, such as a computer. The trackball 1 is mainly installed in the keyboard 3 of personal computer 2 grade, as shown in drawing 35 and 36, and it moves the location of the cursor on a screen according to the hand of cut and rotation when rotating a ball 4 with a finger. If the principle of operation is explained briefly, as shown in drawing 36 , the rotary encoders 7 and 8 which detect a hand of cut and an engine speed through rollers 5 and 6 are formed in the biaxial direction of the X-axis and a Y-axis to a ball 4, and the hand of cut and rotation signal of each rotary encoders 7 and 8 according to the hand of cut of a ball 4 can be detected. This signal is changed into the electrical signal divided into X shaft orientations and Y shaft orientations at the body of a personal computer, it transmits, and the cursor location on a screen is moved according to a signal in the body side of a computer.
[0003] For example, if a ball 4 rotates to X shaft orientations, the shaft 9 of X shaft orientations will rotate and the rotor plate 11 with which two or more slits 10 were formed will rotate. In 2 sets of LED12 and the photo detector 13 which were allotted on both sides of the rotor plate 11, light of LED12 is made a pulse signal by the slit 10, and is changed into an electrical signal by the photo detector 13. Since the hand of cut and engine speed of a rotor plate 11 are detected by this and it shows the rotation of the ball 4 of X shaft orientations, the cursor location on a screen is moved in the direction corresponding to X shaft orientations according to a rotation. Moreover, if the hand of cut of a ball 4 is the direction of 45 degrees to the X-axis and a Y-axis, since the rotation signal of a hand of cut and tales doses will be acquired by coincidence from the rotary encoders 7 and 8 of the X-axis and a Y-axis, according to the signal of each shaft orientations, a cursor location is moved aslant.
[0004] Moreover, about a mouse 15, by carrying out drawing 37 and a configuration as shown in 38, installing a trackball 1 and the same ball 16 in an inferior surface of tongue, and moving the actuation plate 17 or a table all around, the cursor on a screen moves according to this motion, and alter operation is performed by pushing the click carbon button 18 further. In addition, the internal structure is almost equivalent to a trackball 1.
[0005]
[Problem(s) to be Solved by the Invention] In the above-mentioned trackball, there is a possibility that malfunction by invasion of the surroundings or dust which needs a mechanical operation part since it accumulates may occur. Moreover, the tooth space which arranges the trackball itself is needed, and there is a difficulty that it cannot respond to space-saving-ization. Moreover, a mouse also has the same problem as a trackball, and also the flat surface to which a mouse is moved is needed, and there is a difficulty that it cannot be used for a portable small personal computer.

[0006] And the two-dimensional input of each of these pointing devices is enabled, and the switch for giving a click function and a drag function is formed separately. Therefore, it is the hindrance of a miniaturization or space-saving-izing. And the need of moving the cursor of an indicating equipment etc. in three dimension in recent years had arisen, and the three-dimension input was difficult by the device of the conventional pointing device.
[0007] Then, in view of the above, this invention does not need a large actuation tooth space, but aims at offer of input units, such as a computer in which a various functions function [a three-dimension input function, a click function, etc.] input is possible.
[0008]
[Means for Solving the Problem] The movable object 20 which displaces the technical-problem solution means by this invention in three dimension by the load of each direction of a three dimension, A light emitting device 21 and the photo detector 22 which receives the image of light which is optically combined with this light emitting device 21, interlocks and moves to the variation rate of the movable object 20, The optical department 23 which regulates the light which goes to this photo detector 22 is formed in one, and is equipped with the three-dimension input functions and click functions to a display 61, such as a computer.
[0009] And like drawing 1 , the movable object 20 consists of moving part 24 which displaces by artificial actuation, and a fixed part 25 which supports this moving part 24, reflective mold photosensor S which made one the light emitting device 21, the photo detector 22, and the optical department 23 is allotted to a fixed part 25, moving part 24 is countered at photosensor S, and the reflector 34 is formed. The optical department 23 consists of a lens 26 for image formation, and a protection-from-light object 27 which restricts the light which is reflected in a reflector 34 and goes to a photo detector 22 at this time. Or like drawing 28 , a light emitting device 21 and a photo detector 22 counter, and are arranged. This light emitting device 21 is formed in the movable object 20, and the protection-from-light object 91 which has the pinhole 93 as an optical department which regulates the image of the light from a light emitting device 21 between a light emitting device 21 and a photo detector 22, and is led to a photo detector 22 is established. The movable object 20 consists of moving part 24 which displaces by artificial actuation, and a fixed part 25 which supports this moving part 24, a light emitting device 22 is prepared for moving part 24, and a photo detector 22 and the protection-from-light object 91 are formed in a fixed part 25. And either at least has the elastic body among moving part 24 or a fixed part 25.
[0010]
[Function] In the above-mentioned technical-problem solution means, if actuation of adding a load in each direction of a three dimension is carried out to moving part 24 and it is made to do a variation rate in three dimension, the light emitted from the light emitting device 21 reaches a photo detector 22, being able to add a limit to the protection-from-light objects 27 and 91, and the image of light will be interlocked with the variation rate of moving part 24, and will move in a photo detector 22 top. That is, from the two-dimensional variation rate of moving part 24, the image of light only moves in a photo detector 22 top, and calculates the amount of outputs of each future two-dimensional direction. Moreover, to the variation rate of the direction of a three dimension of moving part 24, in order that the optical path of light may receive a limit with the protection-from-light objects 27 and 91, the quantity of light which reaches a photo detector 22 changes. Then, the amount of outputs of the direction of a three dimension is calculated from change of this quantity of light. And three-dimension-[amount / of outputs] the actuation direction and control input of each direction are calculated. By this, the three-dimension input to a computer etc. is performed and the KASORU 62 grade of a display 61 is moved in three dimension.
[0011] Moreover, turning on and off is judged based on the amount of outputs of the direction of a three dimension, and it also becomes possible by inputting this on-off signal into a computer etc. to perform a click function. Thus, one pointing device can perform a various functions input.
[0012]
[Example]
(The first example) The pointing device in which the three-dimension input of this example is possible

The movable object 20 displaced in three dimension by the load of each direction of a three dimension like drawing 1 -3, A light emitting device 21 and the photo detector 22 which receives the image of light which is optically combined with this light emitting device 21, interlocks and moves to the variation rate of the movable object 20, It has in one the optical department 23 which regulates the light which outgoing radiation is carried out from a light emitting device 21, and goes to a photo detector 22, and considers as a plane view T typeface in a convex configuration, and the dimension serves as 25mm of maximum length, the maximum width of 15mm, and height of 10mm. And it is arranged in the condition of having projected from the top face of a key about 1mm to the space surrounded by each key of G, B, and H of the body of a keyboard of devices, such as a personal computer and a word processor.
[0013] Said good dynamic body 20 consists of moving part 24 which displaces by artificial actuation, and a fixed part 25 for attaching moving part 24 in the body of a keyboard, and has integral construction. And the fixed part 25 is equipped with reflective mold photosensor S which made the light emitting device 21, the photo detector 22, and the optical department 23 in one so that moving part 24 may be countered. The optical department 23 consists of a protection-from-light object 27 which restricts the optical path of the light which reflects while restricting the optical path of the lens 26 for image formation, and the light from a light emitting device 21, and goes to a photo detector 22.
[0014] Moving part 24 is formed in the shape of [by which the top face was blockaded] a cylinder, and the bottom serves as the foot 28 jutted out over the longitudinal direction (X shaft orientations). A fixed part 25 is made into the shape of T character, the depression 29 for equipping the inferior-surface-of-tongue side with photosensor S is formed, the foot 28 of moving part 24 is arranged on the top face of X shaft orientations, and the substrate 30 which performs electrical installation with the exterior is attached in the inferior surface of tongue of Y shaft orientations. And it is fixed to the body of a keyboard by forming through tubes 31a and 31b, respectively, ****ing to through tubes 31a and 31b, and inserting 32 in the foot 28 and fixed part 25 of moving part 24.
[0015] And since the movable object 20 needs to produce the variation rate of each direction of the X-axis of a three dimension, a Y-axis, and the Z-axis, a fixed part 25 is fabricated with the rigid body, and moving part 24 is fabricated with the elastic body. As the rigid body, plastics with a thermoplastic degrees of hardness of 98 or more (based on JIS K6301 test method) and a bending modulus of elasticity of 2000kg/cm2 or more (based on ASTM D790 test method), for example, PC (polycarbonate) and ABS (acrylonitrile styrene butadiene rubber), Denaturation PPO (denaturation polyphenylene oxide), etc. are mainly used. Moreover, as an elastic body, the resin of plastics with a thermoplastic degrees of hardness [70-98 (based on JIS K6301 test method)] and a bending elastic modulus of 100-2000kg/cm2 (based on ASTM D790 test method), for example, a polyester elastomer, urethane, or a rubber system etc. is mainly used.
[0016] And let a fixed part 25 and moving part 24 be integral construction with shaping by 2 color shaping from the point of precision and endurance. Moreover, in respect of the problem of metal mold structure, or total cost, insert molding is sufficient and the approach by the stop and the hook stop may be [it may **** and] used. Thus, if the movable object 20 is made into the two-layer structure of ****, as shown in drawing 4 , the variation rate of the movable object 20 can be smoothly carried out to the load to Z shaft orientations which are the load to X two-dimensional shafts each and Y shaft orientations, and the direction of a three dimension, and it will lead to the improvement in the engine performance as a pointing device in which a three-dimension input is possible. In addition, only deltatheta will rotate to the circumference of each shaft, and a two-dimensional variation rate calls this deflection. Moreover, as for the variation rate of the direction of a three dimension, only deltah will fall to Z shaft orientations.
[0017] Moreover, photosensor S of moving part 24 and the inferior surface of tongue of the abbreviation phi5mm ceiling part 33 which counters are made into a reflector 34 for the include-angle detection by photosensor S using the specular reflection of light. That is, a reflector 34 is fabricated by the flat surface and mirror plane finishing, plating processing, or vacuum evaporationo processing is performed. Therefore, the include angle of a reflector changes to a two-dimensional variation rate, and the distance of a reflector 34 and photosensor S changes to the variation rate of Z shaft orientations.

[0018] As other examples of a reflector 34, like drawing 5 , a plate 35 is formed in the ceiling part 33 of moving part 24 in one by 2 color shaping or insert molding by the resin or other rigid resin used for the fixed part 25, and it considers as a reflector 34 by performing surface treatment. If soft like elastic resin, although it is difficult, according to this, since resin is hard, performing direct surface treatment will have the advantage that high flatness is obtained that it is easy to perform surface treatment, and, moreover, it will also become reinforcement of moving part 24. Furthermore, in order to improve condensing to a photo detector 22 according to the condition of the variation rate of moving part 24, it is good also as a curvature side. Thus, since the light from a light emitting device 21 can be used effectively, the output of photosensor S becomes large and a sharp image is moreover obtained by performing surface treatment which serves as a reflector 34, the detection property as a sensor can be raised.

[0019] By the way, as the movable object 20 is not limited to the above-mentioned structure and shown in drawing 6 and 7, some movable objects 20 should just be elastic structures. In addition, as for the slash of **, the lower right in both drawings expresses an elastic body 36, and, as for the slash of **, the lower left expresses the rigid body 37. In drawing 6 (a), a joining segment with the moving part 24 of a fixed part 25 is used as an elastic body 36, the remaining part and the moving part 24 of a fixed part 25 have become the rigid body 37, and the moving-part 24 whole displaces in three dimension. In drawing 6 (b), moving part 24 is used as the rigid body 37, the fixed part 25 serves as an elastic body 36, the moving-part 24 whole displaces in three dimension, and deflection is also large. In drawing 6 (c), a part of moving-part 24 bottom is used as an elastic body 36, the remainder and the fixed part 25 of moving part 24 serve as the rigid body 37, only the moving-part 24 bottom displaces, and the amount of displacement is small. Although a part of moving-part 24 bottom is used as an elastic body 36, the remainder and the fixed part 25 of moving part 24 serve as the rigid body 37 and the moving-part 24 bottom displaces in drawing 6 (d), deflection is not carried out not much greatly. Although the upper half of moving part 24 is used as an elastic body 36, the remainder and the fixed part 25 of moving part 24 serve as the rigid body 37 and only the upper half of moving part 24 displaces in drawing 6 (e), deflection is not carried out not much greatly.

[0020] Moreover, although fitting of the rigid body 37 is carried out in one, the fixed part 25 serves as the rigid body 37 except for a part of inner skin of the moving part 24 which is an elastic body 36 and moving part 24 displaces in drawing 7 (a), deflection is not carried out not much greatly. In drawing 7 (b), except for the lower part of the inside of the moving part 24 which is an elastic body 36, fitting of the rigid body 37 is carried out in one, the fixed part 25 serves as the rigid body 37, the moving-part 24 whole displaces, and the amount of displacement is small. Although are the elastic body 36 with which moving part 24 and a fixed part 25 were united, fitting of the rigid body 37 is carried out to the inside of moving part 24, and the inferior-surface-of-tongue edge of a fixed part 25 in one, the projection 38 which prevents depression of moving part 24 is formed in the inferior surface of tongue of a fixed part 25, the moving-part 24 whole displaces and deflection is large in drawing 7 (c), the variation rate of Z shaft orientations is regulated by projection 38, and is small. Although it is the elastic body 36 with which moving part 24 and a fixed part 25 were united, and fitting of the rigid body 37 is carried out to the inside of moving part 24 in one, the joining segment of moving part 24 and a fixed part 25 is thin, the moving-part 24 whole displaces and deflection seldom enlarges in drawing 7 (d), the variation rate of Z shaft orientations is large. Thus, what was shown in drawing 7 also has the function as a limiter of a variation rate (deflection) while having elastic structure.

[0021] Furthermore, as elastic structure, it can respond not only with selection of an ingredient but with a configuration. That is, a variation rate can be enlarged by forming notching 39 in the peripheral face of moving part 24 like drawing 8 . Moreover, as an example of other cross-section configurations of the elastic body 36 used for some movable objects 20, as shown in drawing 9 , there are a rectangle (this drawing a), a gate type (this drawing b), a gate type (this drawing c) with which the projection was formed in the center, and a thing (this drawing d) which has notching. Like drawing 10 , moving part 24 may be divided up and down, and a spring 40 may be infixed between them further again.

[0022] The primary mold sections 41 which carried out the mold of the hyperfractionation

(quadrisection) photodiode which is LED (light emitting diode) and the photo detector 22 which are a light emitting device 21 as said photosensor S with the epoxy resin of translucency etc., respectively are formed. The secondary mold sections 42 which furthermore carried out the mold of both the primary mold sections 41 with the epoxy resin of protection-from-light nature etc. are formed. The support saddle 44 of the shape of a cylinder of a lens 26 is constituted in one by fitting in removable in the lens frame 43 of the shape of a circular ring which arranged the lens 26 above the light emitting device 21 and the photo detector 22, and was formed in the top face of the primary mold sections 41 and the secondary mold sections 42. In addition, each photodiode of the quadrisection photodiode which is a photo detector 22 is arranged like drawing 11 to the X-axis and a Y-axis as A, B, C, and D, respectively.

[0023] Said protection-from-light object 27 is what formed the protection-from-light nature ingredient in the carrier light emitting devices 21 and 22 of a lens 26, and the inferior surface of tongue which counters in the shape of a thin film by sputtering, vacuum evaporationo, or adhesion, or was formed in one with the lens 26 with protection-from-light nature resin. The circular luminescence aperture 45 which the light from a light emitting device 21 passes in the upper location of a light emitting device 21 like drawing 12 is formed. The light-receiving aperture 46 of the square which the light which goes to a photo detector 22 in the upper location of a photo detector 22 passes is formed, and it is arranged to the medial axis of a lens 26 in the location of the symmetry in X shaft orientations. In addition, the protection-from-light object 27 may be formed in the top face of a lens 26, or may be established between a lens 26 and the carrier light emitting devices 21 and 22. Moreover, since what is necessary is just to be able to detect the light reflected according to the variation rate of moving part 24, it is not necessary to establish only the protection-from-light object 27 to which the photo detector 22 was made to correspond, and to prepare in a light emitting device 21 side.
[0024] And the projection 47 of a circular pair is formed in the top face of the secondary mold sections 42, the depression 29 of a fixed part 25 is equipped with photosensor S, and if it fits into the hole 48 formed in a fixed part 25 and moving part 24 in the projection 47, photosensor S will be contained by the movable object 20 and will become the pointing device of integral construction. Moreover, the lead terminal 49 of a light emitting device 21 and a photo detector 22 is connected to the substrate 30 by the flexible printed wiring board etc.
[0025] And the control means 63 which consists of the microcomputer or Control IC which detects the variation rate of the operated movable object 20 from the output of a photo detector 22, and is outputted as the cursor 62 in the display 61 of the devices 60, such as a computer, or migration information on an icon is formed in the pointing device like drawing 13 . Signal processing of the output current from a photo detector 22 is performed to photosensor S. And X shaft orientations, The analog signal processing circuit section 64 which calculates the output signal of Y shaft orientations and Z shaft orientations is integrated in one. A control means 63 The A/D-conversion section 65 which changes into digital value the analog value outputted from the analog signal processing circuit section 64, The digital digital-disposal-circuit section 66 which changes the output signal by which A/D conversion was carried out into the signal of migration information, such as the actuation direction and a control input, It has the serial interface 67 for enabling connection with the devices 60, such as a computer, and the LED drive circuit section 68 which drives a light emitting device 21.
[0026] The analog signal processing circuit section 64 consists of an electrical-potential-difference transducer 69 which carries out electrical-potential-difference conversion of the output current from a photo detector 22, the addition processing section 70 adding the output voltage of 2 sets of predetermined photodiodes A, B, C, and D, and the subtraction processing section 71 which calculates the output of X shaft orientations, Y shaft orientations, and Z shaft orientations from the added output voltage like drawing 14 . In addition, the electrical-potential-difference transducer 69 has the operational amplifier 72 and resistance R1 corresponding to each photodiodes A, B, C, and D, the addition processing section 70 has four operational amplifiers 73 and resistance R2, and the subtraction processing section 71 has three operational amplifiers 74 and resistance R2.
[0027] Moreover, in the digital digital-disposal-circuit section 66, the direction and magnitude of a load

are computed by compounding the vector of the output of each shaft orientations, and data processing which determines the migration direction of cursor 62, passing speed, acceleration, etc. from these is performed. Or after carrying out A/D conversion instead of this data processing, the simple approach of decomposing the vector of the processing like software, for example, the output of each shaft orientations, into a devices side, such as a computer, with the respectively required number of decomposition, making a matrix combination for several of those decomposition minutes, and making it into the direction and magnitude of a three dimension may be enforced.

[0028] Next, the input process when operating the detection principle of a pointing device and a pointing device is explained. First, to a two-dimensional input, as shown in drawing 12 , the reflector 34 of moving part 24 is located from the base of photosensor S in the location of H, and when not operated, it does not have the inclination of a reflector 34. The light emitted from the light emitting device 21 passes along the luminescence aperture 45 of the protection-from-light object 27, it is reflected through a lens 26 in a reflector 34, and it passes along the light-receiving aperture 46 of the protection-from-light object 27 through a lens 26 further, and sets it image formation as the core of a photo detector 22. Here, if the ceiling part 33 of moving part 24 is operated in the two-dimensional direction by the fingertip, moving part 24 will displace in the upper part [root / of the foot 28 supported to the fixed part 25], will be in the condition that moving part 24 inclined for a while, and change will produce it at the include angle of a reflector 34 and the optical axis of photosensor S. Therefore, although the light irradiated from the light emitting device 21 passes the luminescence aperture 45 and a lens 26, it is reflected by the reflector 34 of moving part 24, a lens 26 and the light-receiving aperture 46 are passed again and image formation is carried out on a photo detector 22, the image of the light received by the photo detector 22 is moving before and after displacement of moving part 24.

[0029] At this time, as shown in drawing 15 , the variation rate of a reflector 34 serves as rotation centering on the Y-axis which intersects perpendicularly with the shaft, i.e., the X-axis, and this with which a light emitting device 21 and a photo detector 22 are located in a line with the variation rate of moving part 24. From this, the load direction given by artificial actuation can be transposed to the 2-way of the hand of cut consisting mainly of the X-axis and a Y-axis, change of the include angle of a reflector 34 can be detected, and input process can be performed. For example, the image of the light on a photo detector 22 moves to Y shaft orientations by rotation of the circumference of the X-axis shown in drawing 16 . Moreover, the image of the light on a photo detector 22 moves to X shaft orientations by rotation of the circumference of the Y-axis shown in drawing 17 .

[0030] The current value acquired with four photodiodes A, B, C, and D of a photo detector 22 is set to ISCA, ISCB, ISCC, and ISCD, respectively. And if electrical-potential-difference conversion of the output current of each photodiodes A, B, C, and D is carried out by the electrical-potential-difference transducer 69, it will be set to VA=R1xISCA, VB=R1xISCB, VC=R1xISCC, and VD=R1xISCD, respectively. Next, since the image of light moves to Y shaft orientations by the deflection of a reflector 34 to rotation of the circumference of the X-axis, it divides into 2 sets, Photodiodes A and C and Photodiodes B and D, and each output voltage is added. Similarly, to rotation of the circumference of a Y-axis, it divides into 2 sets, Photodiodes A and B and Photodiodes C and D, and each output voltage is added. Thereby, to rotation of the circumference of the X-axis, - (VA+VC) and - (VB+VD) are obtained as an output from the addition processing section 70, and - (VA+VB) and - (VC+VD) are obtained to rotation of the circumference of a Y-axis. And VY=(VA+VB)-(VC+VD) is obtained by the subtraction processing section 71 as an output of VX=(VA+VC)-(VB+VD) and Y shaft orientations as an output of X shaft orientations, respectively.

[0031] At this time, the relation between angle of rotation of the circumference of the X-axis and VX serves as a S character curve which has a linear output change as shown in drawing 18 . Similarly, the relation between angle of rotation of the circumference of a Y-axis and VY serves as a S character curve which has a linear output change as shown in drawing 19 . Therefore, in the linear output range of VX, VX is uniquely determined to X-axis angle of rotation, and VY is uniquely determined to Y-axis angle of rotation in the linear output range of VY. By rotation of the circumference of the X-axis, at the time of calculation of VX and VY, in addition, A and each photodiode of C, B, and D, Having added the

output voltage of A and each photodiode of B, C, and D in rotation of the circumference of a Y-axis, respectively It is for enlarging light-receiving area which can be effectively used to the migration direction of the image of light, and also in order to absorb dispersion in the optical axis by assembly dispersion on real use, the above-mentioned addition processing becomes effective.

[0032] And if the output of VX and VY is obtained by the analog signal processing circuit section 64, the load direction over the load added to the movable object 20 by the composition of vectors of a 2-way as shown in drawing 20 , and its magnitude will be called for. That is, it is theta=tan, when a direction is set to theta and magnitude is set to V. - 1 (VY/VX) (1)

V=VX/costheta=VY/sintheta =VX/cos (tan-1 (VY/VX))

=VY/sin(tan-1(VY/VX)) (2)

As mentioned above, if VX and VY can be found, Direction theta and magnitude V will be determined. And based on theta and V which were determined, the two-dimensional migration direction and the passing speed of cursor 62, acceleration, etc. are called for.

[0033] Moreover, to the variation rate of Z shaft orientations which are the directions of a three dimension, as shown in drawing 21 , moving part 24 is pushed downward and displaces to Z shaft orientations. Then, the light emitted from the light emitting device 21 passes along the luminescence aperture 45 and a lens 26, and is reflected in a reflector 34. The reflected light reaches the protection-from-light object 27 through a lens 26 again. And although light passes along the light-receiving aperture 46 and a photo detector 22 is reached, with the protection-from-light object 27, an optical path is interrupted and a part of light cannot reach a photo detector 22. Therefore, the quantity of light received by the photo detector 22 becomes less than the quantity of light before displacing in the direction of a three dimension, and changes before and after displacement of moving part 24. Then, in the analog signal processing circuit section 64, VZ=VA+VB+VC+VD is obtained based on the light income of a photo detector 22 as an output of Z shaft orientations. Here, when moving part 24 displaces only deltaH, it is shaded with the protection-from-light object 27, and not all the light from a light emitting device 21 reaches a photo detector 22. By the above, the absolute value of each output VZ before and behind displacement by Z shaft orientations of moving part 24 is compared, and the variation rate of Z shaft orientations can be detected.

[0034] And the analog signal over each direction of the three dimension acquired as mentioned above is inputted into a control means 63, and digital conversion is carried out by the resolving power needed by the A/D-conversion section 65. As resolving power, 4 bits or about 8 bits are appropriate. The signal by which A/D conversion was carried out is changed into the serial signal of X for a three-dimension input, Y, and Z shaft orientations by the digital digital-disposal-circuit section 66, and outputs and inputs between the mouse interfaces of the devices 60, such as a computer, through a serial interface 67.

[0035] Therefore, by operating the movable object 20 in each two-dimensional direction, an output is obtained corresponding to the actuation direction and control input, and cursor 62 can move only a desired distance towards desired in a display 61 by this. That is, if the load added to the movable object 20 is enlarged, cursor 62 will move in the added load direction with quick passing speed, and if a load is made small, it will move slowly. And if a finger is lifted from the movable object 20, migration of cursor 62 will stop. Moreover, by operating the movable object 20 to Z shaft orientations, the migration length of the direction of a three dimension in the display 61 corresponding to the control input is obtained, and KASORU 62 can be moved in three dimension in a display 61.

[0036] Moreover, a click function can also be added by actuation to Z shaft orientations of the movable object 20. That is, it is made binary by whether it is over the threshold with the output from photosensor S, if higher than a threshold, an ON signal will be outputted, and if lower than a threshold, the input as a click function or a drag function can be performed by establishing a click means to output an off signal. In addition, there is no input function to the direction of a three dimension in this case only at a two-dimensional input function. Then, if it will judge having clicked if it is time amount shorter than predetermined time that what is necessary is to add a time element, to measure the output time amount from photosensor S obtained by actuation to Z shaft orientations, and just to distinguish from the time amount in case actuation of the movable object 20 is detected in order to also add a click function, with

a three-dimension input function having, and it excels rather than predetermined time, it judges that it is a three-dimension input, and each function will perform.

[0037] Next, the result checked by optical simulation (the ray-tracing approach) is shown in drawing 22 about VX obtained by the pointing device of this example and VY serving as a linear output change to each angle of rotation. Parameters, such as a refractive index of the resin which discharges and uses 120 beams of light in a certain solid angle deltaomega in the point light source from a light emitting device 21, and curvature of a lens 26, were inputted into the computer, simulation was carried out about each beam of light according to the principle of reflection and refraction, and this simulation estimated 120 duties which discharged the reinforcement of the beam of light which finally reaches to a photo detector 22. In the above technique, 120 were discharged, having used the strength of the beam of light per one as 100 the first stage (total reinforcement is 120x100=12000), and the results of an operation VX and VY of the reinforcement obtained by the axis of abscissa by the photo detector 22 in angle of rotation considering the reinforcement obtained by the photo detector 22 of a quadrisection photodiode as VX= (A+C)-(B+D) and VY=(A+B)-(C+D) are graph-ized. The S character curve of VX and VY is obtained also from this simulation result to change of an include angle, and it turns out that it is possible to change into the direction theta shown by the above-mentioned formula (1) and (2) and magnitude V by making a linear output change field into the use field as a pointing device. In addition, the offset gap is produced in the Y-axis hand of cut in this simulation result, because the physical relationship of the light emitting device 21 and photo detector 22 of Y shaft orientations has shifted from the optimal location, and it can ask for the optimal location by repeating simulation.

[0038] Moreover, in the simulation result of the variation rate of Z shaft orientations, as for by performing conditioning of the above-mentioned parameter, as shown in drawing 23 , only deltaH shows that light does not reach a photo detector 22 in the location where the reflector 34 fell, when [=] the maximum distance from 1.5mm, however a lens 26 to a reflector 34 is 2.4mm. Furthermore, where deflection is carried out, when the variation rate was made to carry out in the direction of a three dimension and it checked, it also turned out that the conditions to which light does not reach a photo detector 22 with the magnitude of deltaH are acquired. That is, the magnitude and physical relationship of each apertures 45 and 46 in the value of deltaH to the distance H of a reflector 34 and photosensor S and the protection-from-light object 27 must be designed in consideration of parameters, such as physical relationship of a photo detector 22 and a light emitting device 21, and a focal distance of a lens 26.

[0039] Thus, by constituting from photosensor S and a movable object 20 which contains it and which is displaced in three dimension as a pointing device, with one device, a various functions input is attained, components mark can be reduced, a miniaturization can be attained, installation to the space surrounded by each key of a keyboard is attained, and space-saving-ization of devices, such as a computer, can be attained. And since the non-contact optical method is used, the mechanical operation section does not exist, but high-reliability is acquired, and it can be equal to prolonged use. Moreover, since the variation rate of all the directions of a three dimension is detectable in analog, input process can be performed easily. Therefore, software for input process can be made easy and, on the whole, the cheap pointing device of cost can be offered.

[0040] By the way, while the devices 60, such as a computer, turn on and being able to attain low consumed-electric-current-ization if a light emitting device 21 is driven so that light may be emitted intermittently, and the output current from a photo detector 22 is detected according to this timing instead of making a light emitting device 21 always emit light since alter operation by the pointing device is not necessarily always performed, the effect of disturbance, such as a noise, can also be eliminated and dependability can be raised.

[0041] Although considered as a click means to obtain an on-off signal by making binary the output from photosensor S by the variation rate of Z shaft orientations, in the above-mentioned example, when the movable object 20 was pushed in, a feeling of a click was not obtained, but there was sense of incongruity in human engineering. Then, in order to give a feeling of a click to the variation rate of Z shaft orientations, in the moving part 24 which consists of an elastic body, it considers as the structure

connected by the connection section 80 in which the ceiling part 33 in which the reflector 34 was formed, and the lower part laid in a fixed part 25 had an include angle (30 - 40 degrees) with thin thickness (0.4mm) like drawing 24 . In addition, other configurations are the same as the above-mentioned example. Moreover, it considers as the structure which put the control unit 81 which turns into a ceiling part 33 from the rigid body of a major diameter so that it may connect by the connection section 80 in which the ceiling part 33 in which the reflector 34 was formed in the moving part 24 which consists of an elastic body like drawing 25 as other examples, and the lower part laid in a fixed part 25 had an include angle (30 - 40 degrees) with thin thickness (0.4mm), the still more nearly same feeling of actuation as a mouse may be obtained and positive actuation can be performed. In order to raise the reinforcement of a ceiling part 33 at this time, the thickness of a ceiling part 33 is thick, and about the distance of photosensor S and a reflector 34, since initial-complement ****** becomes there is not less, the center of an inferior surface of tongue of a ceiling part 33 has become depressed. When moving part 24 is pushed in by considering as such structure, if it displaces to some extent, the connection section 80 will deform rapidly, it will become KAKUTSU, and a feeling of a click will be obtained. Therefore, the feelings that the click function was performed are obtained and it becomes improvement in operability.

[0042] Furthermore, as the above-mentioned application, like drawing 26 and 27, projection 82 is installed from the inferior surface of tongue of a ceiling part 33, and a conductor 83 is formed in the lower limit in drawing 24 and the movable object 20 shown in 25. And the electric conduction pattern 84 with which the middle broke off is formed in the substrate 30 which countered the projection 82, projection 82 falls with the variation rate of Z shaft orientations of moving part 24, and a conductor 83 gives a switch function by contacting the electric conduction pattern 84 and making it flow. Therefore, you may develop to a click function or a drag function by making this into a click means, and may add to a pointing device as a still newer switch function, and a various functions pointing device can be attained.

[0043] If the signal corresponding to the actuation direction and a control input is inputted into a computer etc. further again based on the absolute magnitude of the output VZ of photosensor S obtained from the variation rate of Z shaft orientations of the movable object 20 when a projection etc. constitutes a click means like the above, KASORU etc. can be moved in three dimension. By this, it can be made a pointing device with a three-dimension input function and a click function.

[0044] (The second example) In this example, like drawing 28 , the light emitting device 21 was prepared for the moving part 24 which can move up and down, the light emitting device 21 was made to counter and the photo detector 22 is formed. The light emitting device 21 is carried in the substrate 90 fixed to the ceiling part 33 of moving part 24. The interior of the photo detector 22 is carried out to the electrode holder 91 which is the protection-from-light object fabricated with protection-from-light nature resin, and it is carried in the substrate 92 fixed to the base of an electrode holder 91. A fixed part 25 is equipped with an electrode holder 91, and the pinhole 93 circular as an optical department which restricts the passing light is formed in the top face of the electrode holder 91 between the opticals axis which connect a light emitting device 21 and a photo detector 22. A transparency mold photosensor is constituted by this. In addition, it is LED, a photo detector 22 is a quadrisection photodiode, and the structure of the movable object 20 of a light emitting device 21 is the same as the first example.

[0045] According to this configuration, when artificial actuation is not added, the light irradiated from the light emitting device 21 like drawing 29 passes through a pinhole 93, a photo detector 22 is reached, but the spot image of the light on a photo detector 22 is small, and its total light income of a photo detector 22 is also small. This is only for the light for a solid angle of deltaomega to become effective, and to reach a photo detector 22. If operated in the two-dimensional direction, like drawing 30 , corresponding to the variation rate of moving part 24, a light emitting device 21 will also interlock, and will be moved, and the spot image of light which it irradiates from a light emitting device 21, passes through a pinhole 93, and reaches a photo detector 22 will move a photo detector 22 top to the direction and 180-degree hard flow of a variation rate of moving part 24 with the almost same magnitude as the time before actuation. In addition, the detection approach of the output from this photo detector 22 is the same as that of the first example. However, the output change to an include angle replaces the output

change to a variation rate.
[0046] Furthermore, if moving part 24 is held down and it displaces to Z shaft orientations, like drawing 31 , spacing of a light emitting device 21 and a pinhole 93 becomes short, the light which reaches a photo detector 22 becomes a part for the solid angle of deltaomega' (>deltaomega), the spot image of the light on a photo detector 22 will become large, and the total light income will also become large. Here, change of the total light income to the variation rate of Z shaft orientations is shown to drawing 33 . When d' and the relative light requirement at that time are made into I' for the distance from the light emitting device 21 after displacement to a pinhole 93 like drawing 33 , the relation between the distance from a light emitting device 21 to a pinhole 93 and a relative light requirement is I'=Ix(d/d') 2. (3) It becomes. d is the distance from the light emitting device 21 when you have no variation rate to a pinhole 93, and I is a relative light requirement at that time.
[0047] Next, if it is operated in the two-dimensional direction, pressing down to Z shaft orientations, like drawing 32 , moving part 24 displaces in three dimension, the spot image of light will become what compounded the migration to the variation rate of each above-mentioned direction, and the migration length of the spot image of the light to the variation rate to the two-dimensional direction will become large. In this case, amount of displacement deltaL' of the spot image of the light on a photo detector 22 is as follows.
[0048] deltaL'=deltaLxD/d' (4)
deltaL: -- the variation rate of a light emitting device 21 -- amount D: -- the distance (regularity) from a pinhole 93 to a photo detector 22
d': -- the distance from a pinhole 93 to a light emitting device 21 -- deltaL' will become a big change if a load is added also in the two-dimensional direction in this way, adding a load to Z shaft orientations, and deltaL is equal as compared with the time of not adding a load to Z shaft orientations, since d' becomes small. That is, the outputs VX and VY of the two-dimensional direction over a variation rate change the unit variation of the serpentine curve to amount of displacement deltaL in the time of not adding with the time of adding a load to Z shaft orientations, as shown in drawing 34 (a). Here, when the load to Z shaft orientations is added, sensibility becomes high rather than the time of not adding a load to Z shaft orientations only b/a times. At this rate, since the output of the two-dimensional direction changes by the existence of the load to Z shaft orientations, a feeling of actuation will worsen. Then, in order to amend this sensibility difference, by applying the correction factor based on a formula (3), as shown in drawing 34 (b), change of the outputs VX and VY of the two-dimensional direction in the linear output range of the serpentine curve to amount of displacement deltaL can be carried out to regularity regardless of the amount of displacement to Z shaft orientations, and a suitable feeling of actuation can be obtained. For example, when change of distance d' from a pinhole 93 to a light emitting device 21 is set to one half, the total light income of a photo detector 22 becomes 4 times, and the sensibility to amount of displacement deltaL of the outputs VX and VY of the two-dimensional direction also becomes 4 times. It acts as the monitor of the change of distance d' from the total light income of a photo detector 22, and a correction factor is applied to VX and VY. In this case, by doubling 1/4, it can be made equal to the sensibility to amount of displacement deltaL of VX when not adding the load to Z shaft orientations, and VY.
[0049] As mentioned above, if the output of photosensor S to the variation rate to each direction of a three dimension is obtained, according to the signal-processing approach shown in the first example after that, the amount of outputs of each direction of the X-axis, a Y-axis, and the Z-axis will be calculated, the actuation direction and control input to the movable object 20 will calculate, and three dimension migration control of cursor 62 will be performed. Therefore, that there should just be a tooth space which with such structure it becomes unnecessary to arrange a light emitting device 21 and a photo detector 22 side by side, and can arrange only one component, since the movable object 20 can be made thin, a pointing device can be miniaturized further.
[0050] Moreover, a click function can be added by considering a time element to actuation of Z shaft orientations as mentioned above. Furthermore, a two-dimensional input function and a click function may be combined instead of a three-dimension input function.

[0051] In this example, instead of arranging the direct light emitting device 21 to moving part 24, a light emitting device 21 may be arranged to a fixed part 25, and lightguides, such as an optical fiber which leads the light from a light emitting device 21 to the ceiling part 33 of moving part 24, may be prepared in the interior of moving part 24. According to this, while being able to make the movable object 20 thin, the dimension of the height direction can also be shortened and serves as a small pointing device. Moreover, it is good also as structure which has arranged the photo detector 22 to moving part 24, and has arranged the light emitting device 21 to the fixed part 25.
[0052] In addition, as for this invention, it is needless to say that it is not limited to the above-mentioned example and many corrections and modification can be added to the above-mentioned example within the limits of this invention. For example, although the fixed part and moving part of a movable object fabricated with the heterogeneous ingredient, respectively, by filling the degree of hardness and bending elastic modulus to the rigid body or an elastic body with the same ingredient, they may fabricate a fixed part and moving part with the same ingredient, and can reduce ingredient cost compared with the case where a heterogeneous ingredient is used.
[0053] moreover -- as a photo detector -- instead of [of a quadrisection photodiode] -- two-dimensional -- PSD (semi-conductor location sensing element) is used. If the light reflected in this PSD in the reflector reaches, since the charge proportional to light energy is generated in an incidence location, this charge is outputted as a current and it can ask for the incidence location of light, the output of X shaft orientations and Y shaft orientations is obtained, the output of Z shaft orientations is also further obtained from a full force force current, and a three-dimension input is possible. Moreover, using four photodiodes as a photo detector, four photodiodes may be arranged so that the perimeter of a light emitting device may be surrounded on the X-axis centering on the light emitting device which is LED, and a Y-axis.
[0054] Furthermore, it is possible it not only to install a pointing device between the keys of a keyboard, but to use it as an object for navigation systems which requires substitution, or the switch and direction directions of the joy stick of a computer-game machine or a mouse, installing in another tooth spaces other than a keyboard. And it is applicable also to the application which performs the communication link with the body of a computer through a connector like a mouse.
[0055]
[Effect of the Invention] The movable object which is displaced in three dimension by the load of each direction of a three dimension according to this invention a passage clear from the above explanation, By preparing in one the optical department which regulates the light which goes to a carrier light emitting device and a photo detector, and making a three-dimension input function and a click function have It can become possible to perform many functions with one pointing device, multi-functionalization of a pointing device can be realized, a miniaturization and space-saving-ization can be attained, and it can contribute to the miniaturization of devices, such as a computer.
[0056] And while being able to lose the mechanical operation section, and there being no change in detection precision by making detection of the variation rate of a movable object into a non-contact optical method and being able to offer a pointing device with high dependability, in a software side, signal processing of the output from a photo detector can be performed simply, and the pointing device which cost does not apply synthetically can be realized.
[0057] Moreover, by preparing either the light emitting device by which opposite arrangement was carried out, or a photo detector in a movable object, installation area can be lessened compared with the case where a light emitting device and a photo detector are arranged side by side horizontally, and space-saving-ization can be attained further.
[0058] Furthermore, since either has the elastic body, the three-dimension-variation rate of a movable object of it can become possible, it can carry out a variation rate certainly to the load added to the movable object, and can make an input as meant perform at least among moving part or a fixed part.

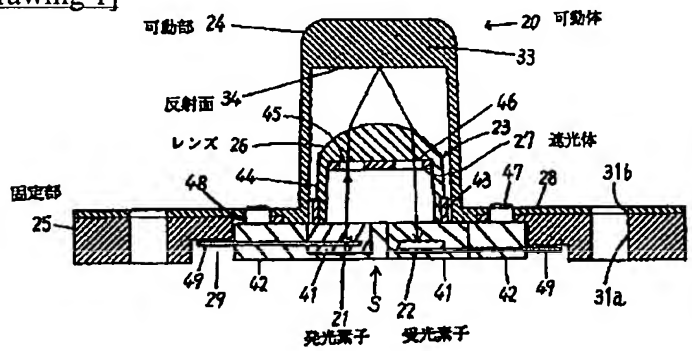
[Translation done.]

* NOTICES *

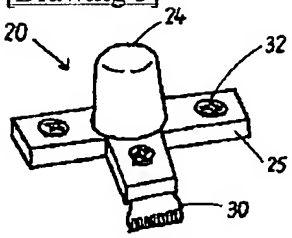
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

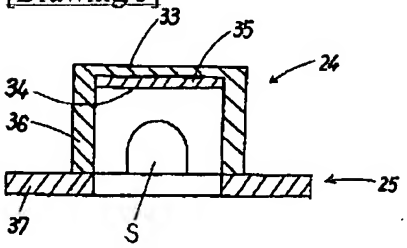
[Drawing 1]



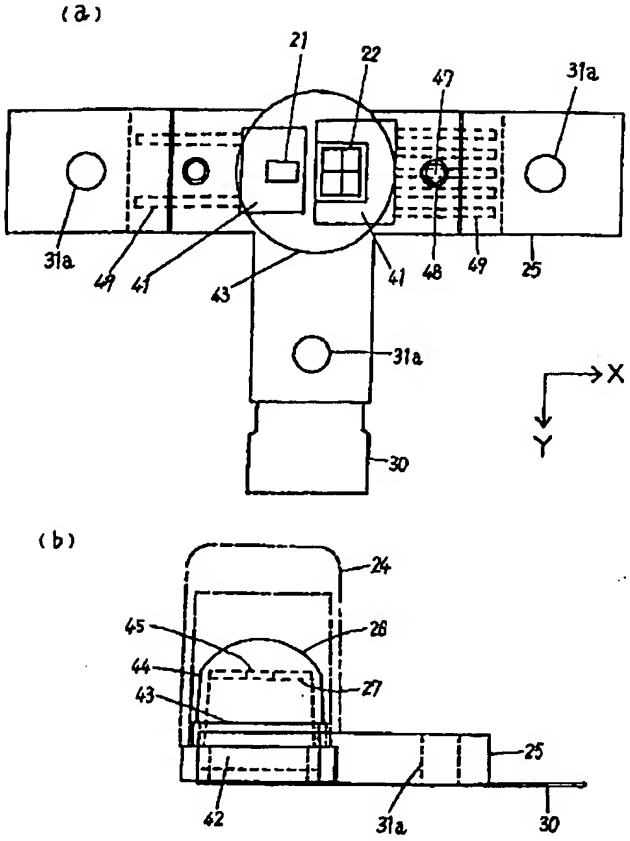
[Drawing 3]



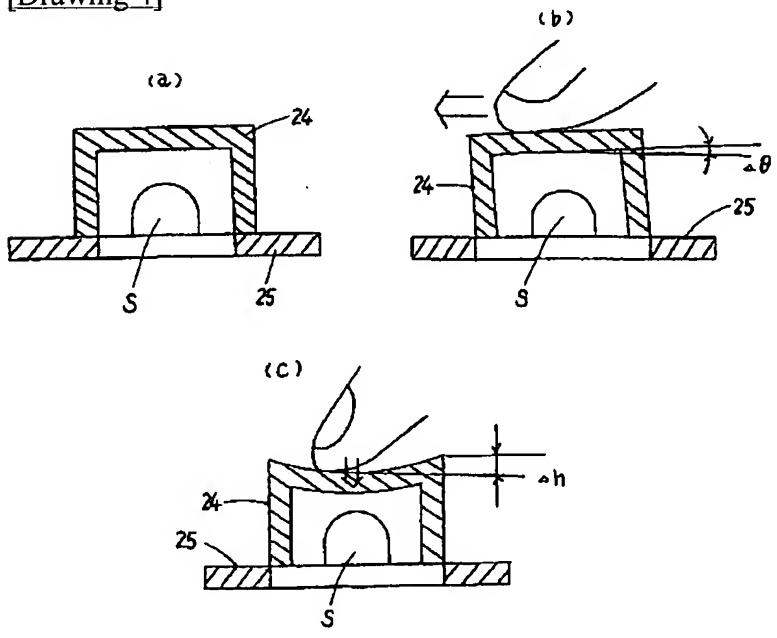
[Drawing 5]



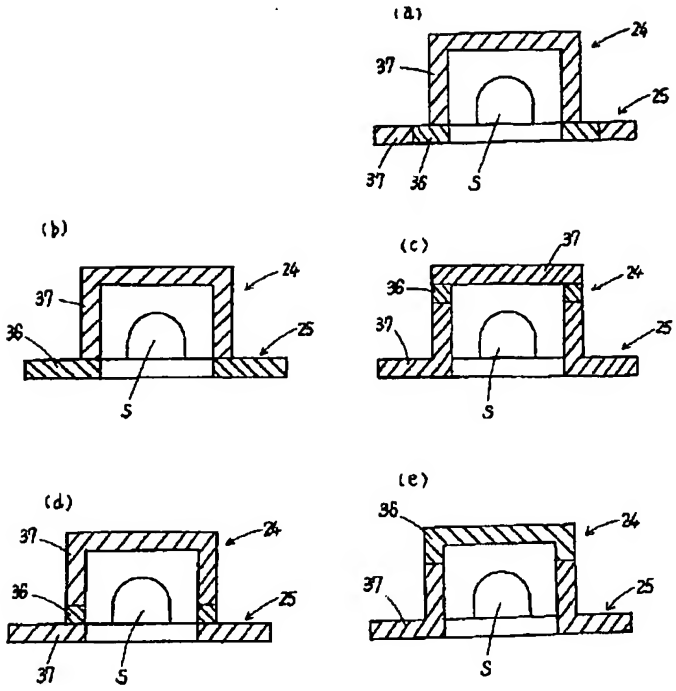
[Drawing 2]



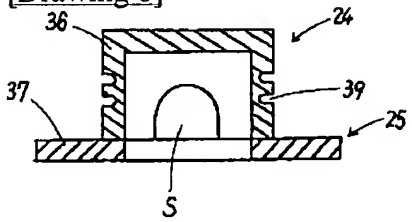
[Drawing 4]



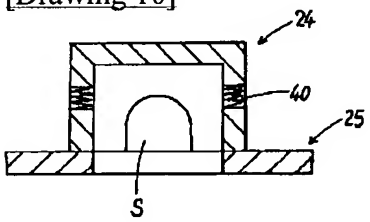
[Drawing 6]



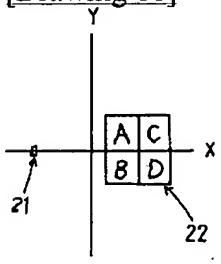
[Drawing 8]



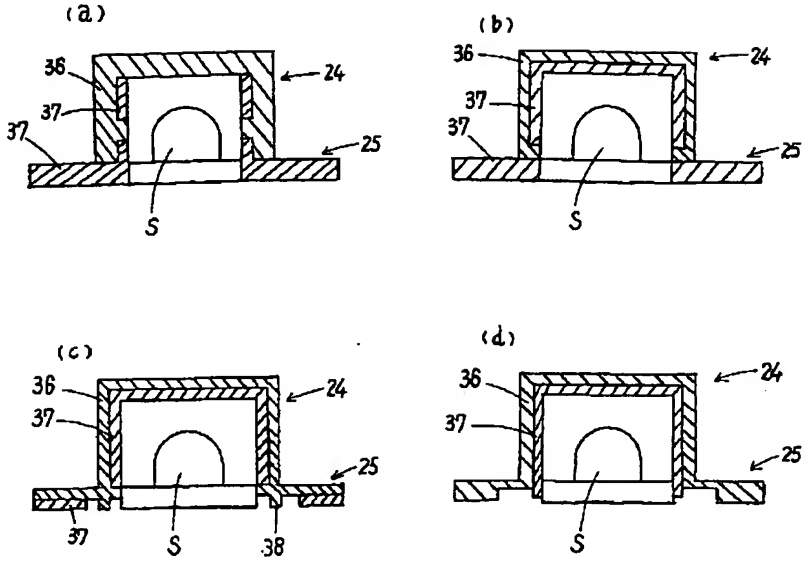
[Drawing 10]



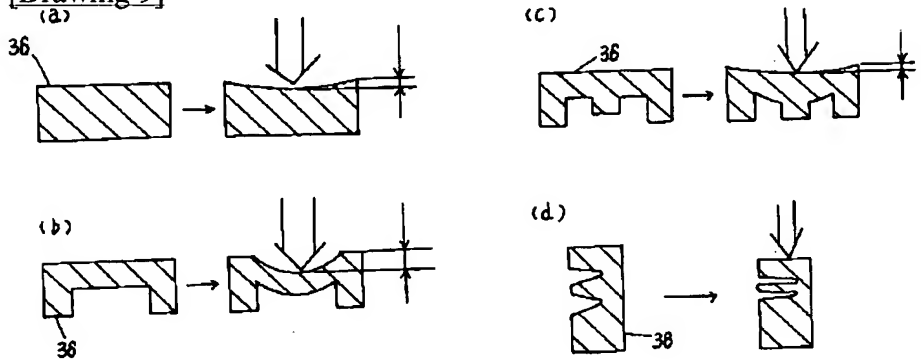
[Drawing 11]



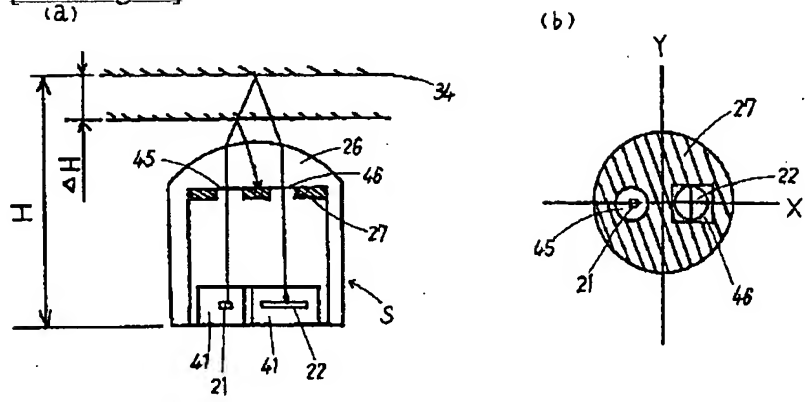
[Drawing 7]



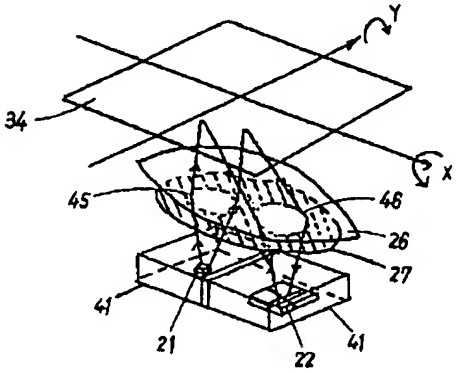
[Drawing 9]



[Drawing 12]



[Drawing 15]



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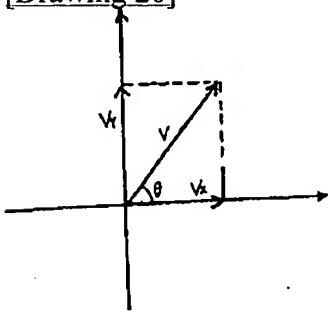
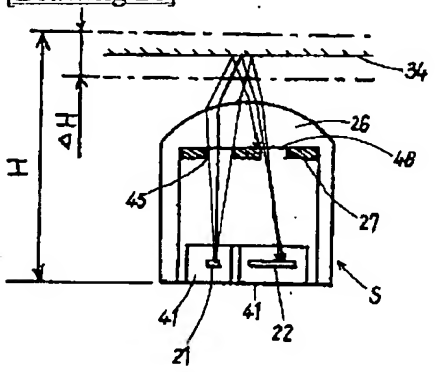
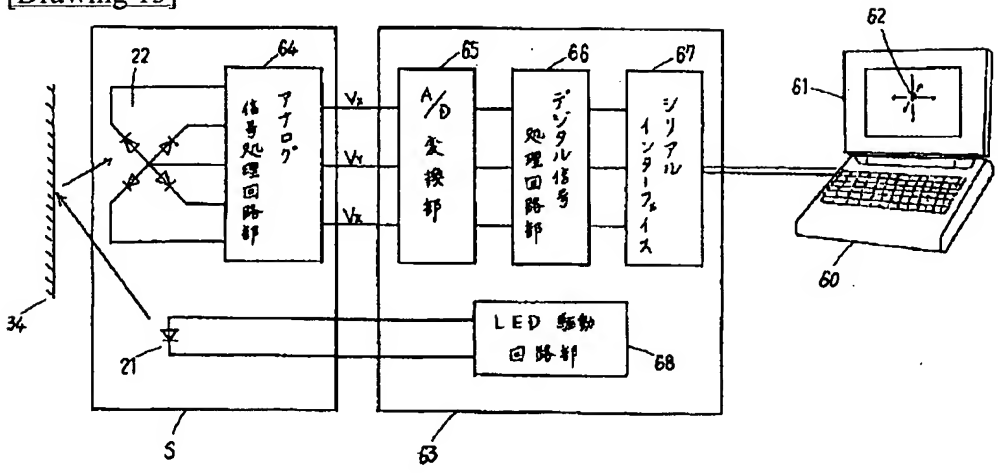


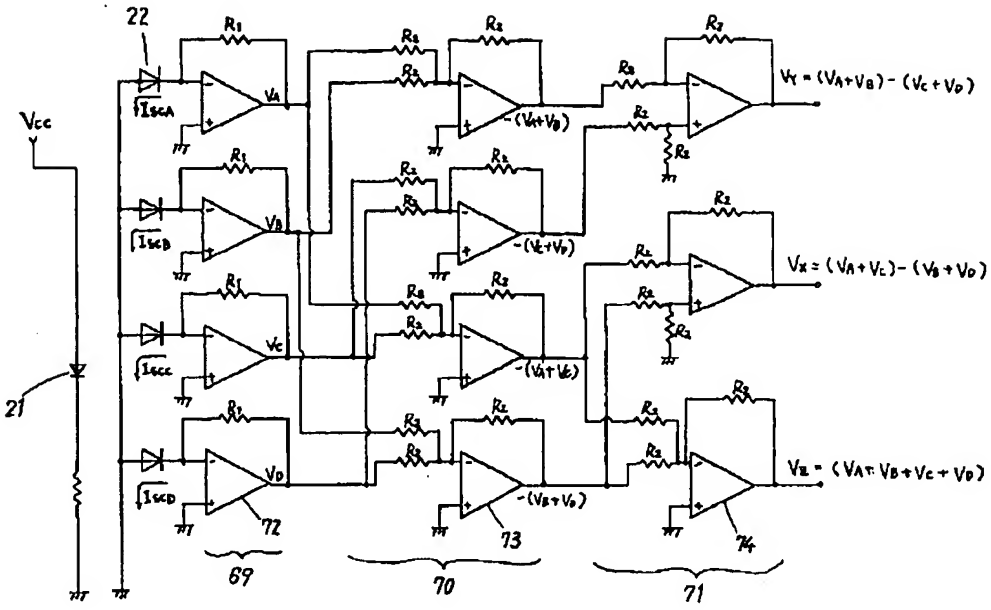
[Drawing 21]



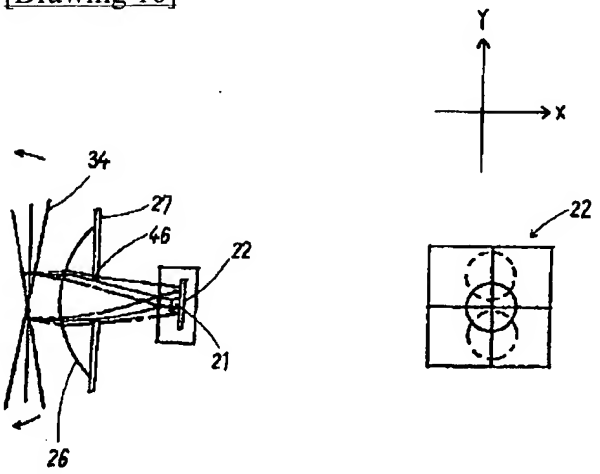
[Drawing 13]



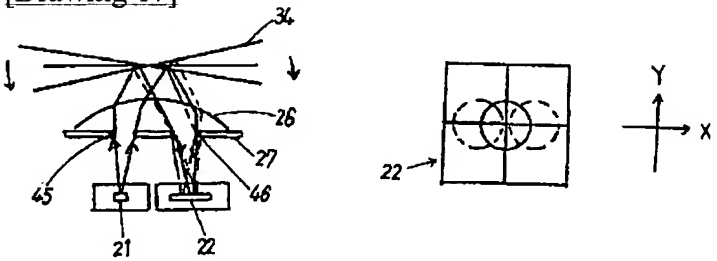
[Drawing 14]



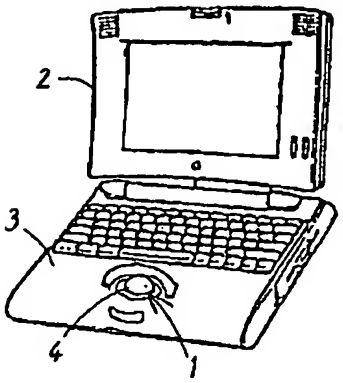
[Drawing 16]



[Drawing 17]



[Drawing 35]



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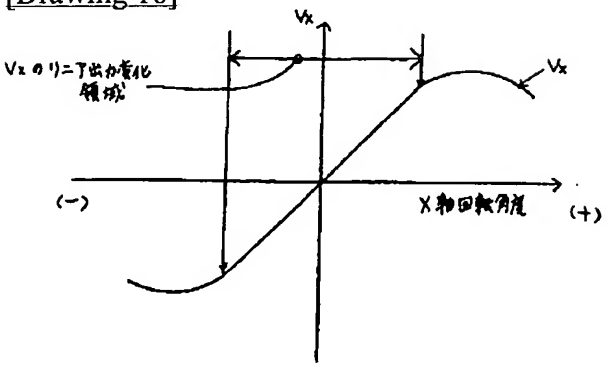

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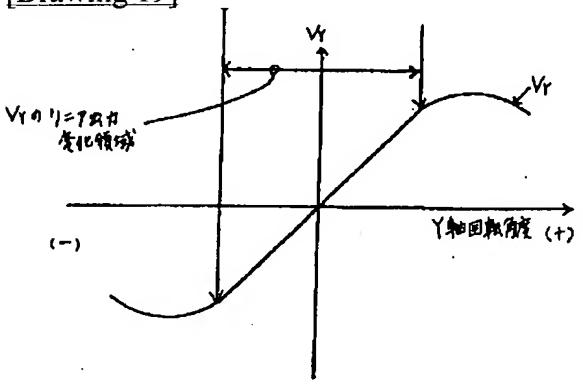

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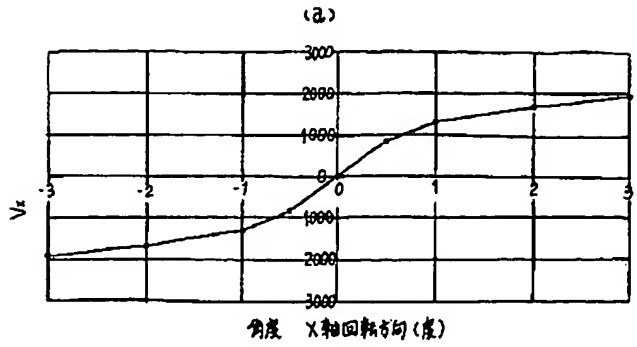
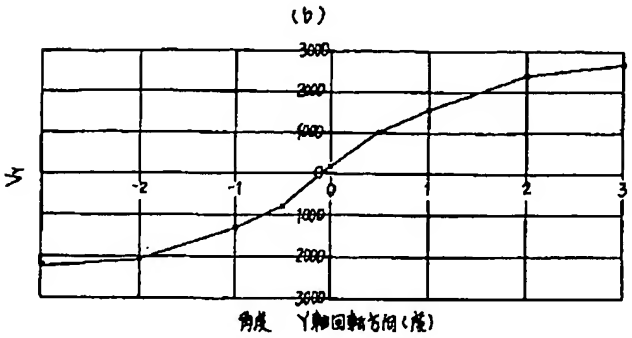
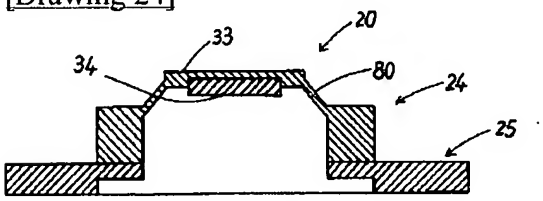




[Drawing 24]



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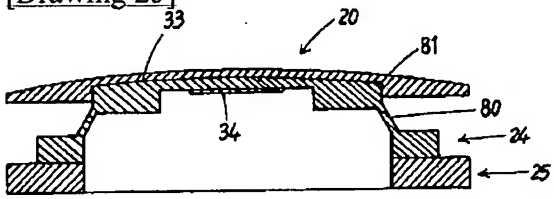

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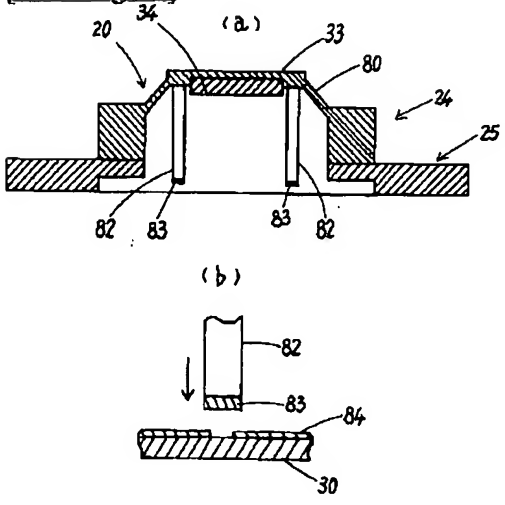

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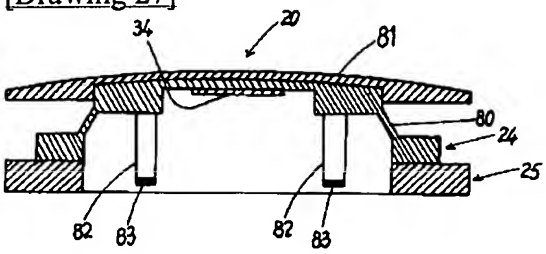

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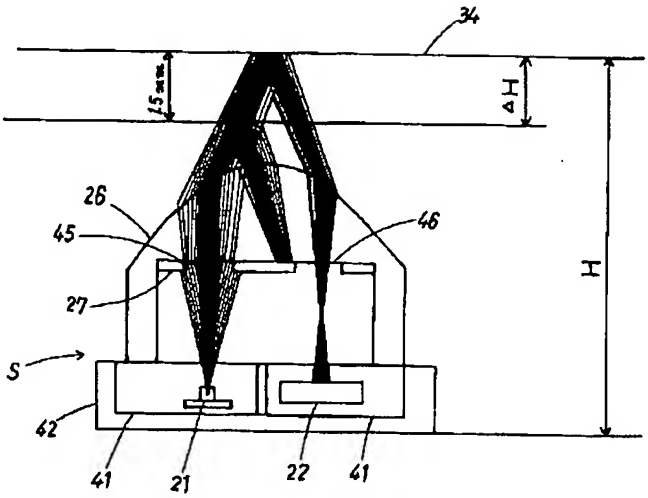

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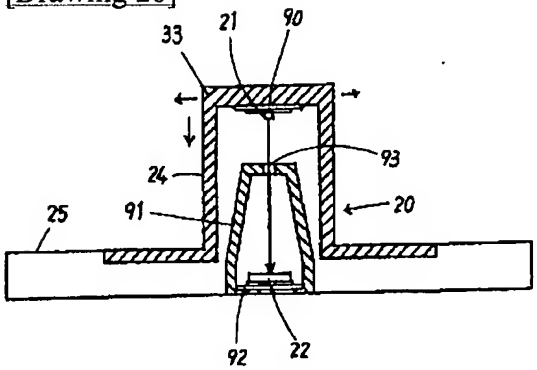

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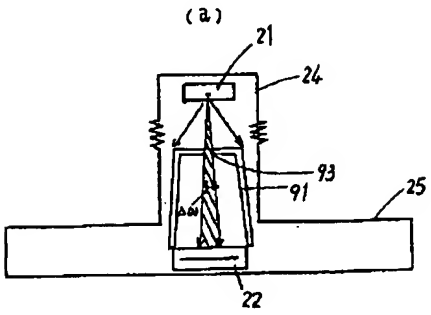
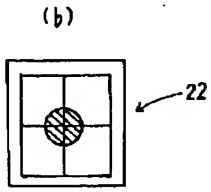
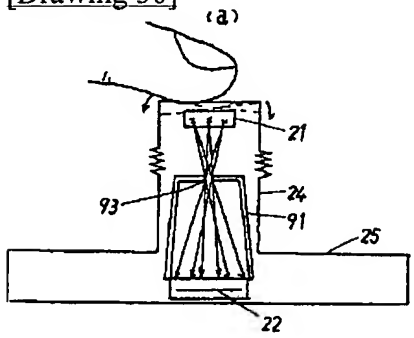
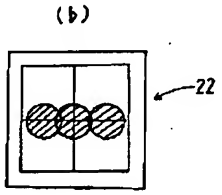


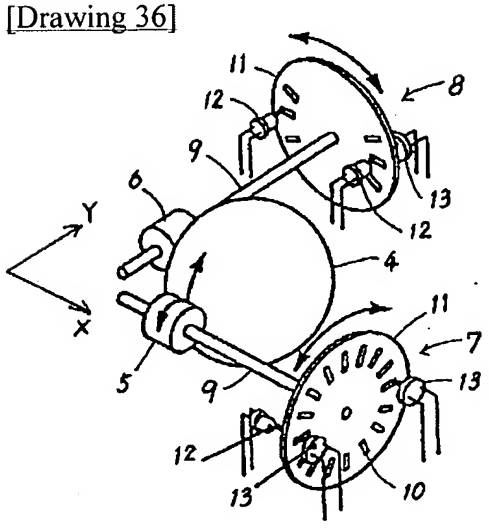


[Drawing 30]

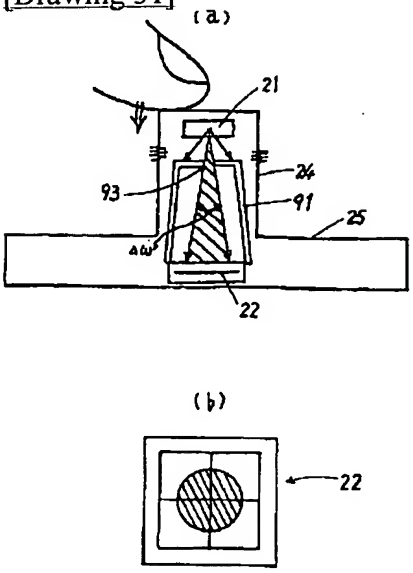




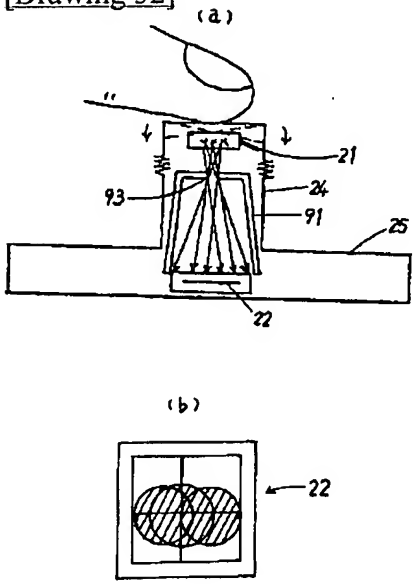
[Drawing 36]



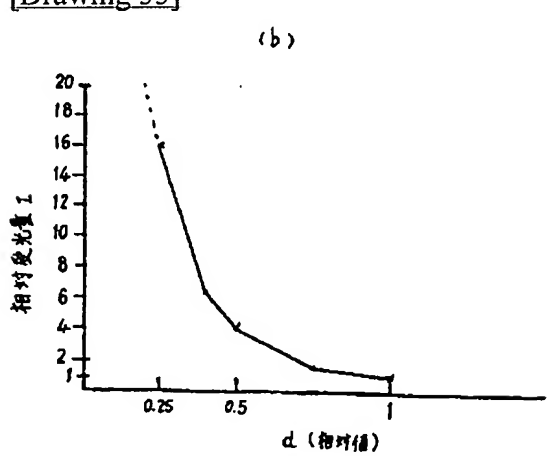
[Drawing 31]

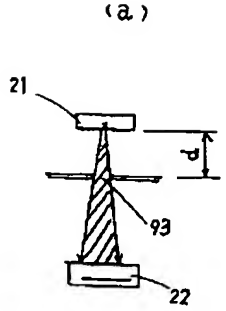


[Drawing 32]

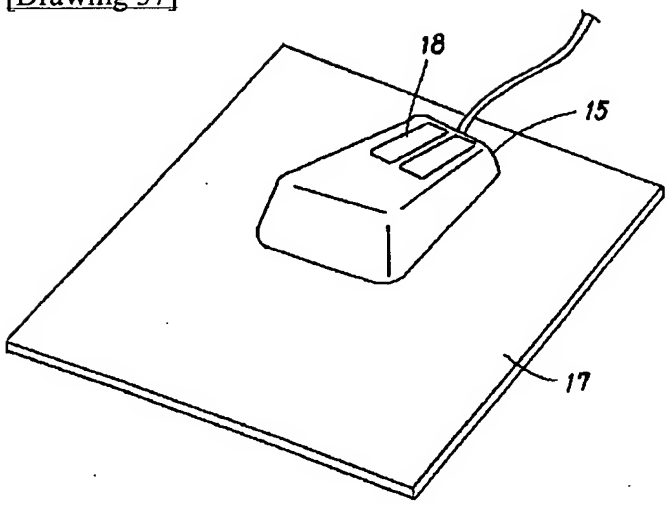


[Drawing 33]

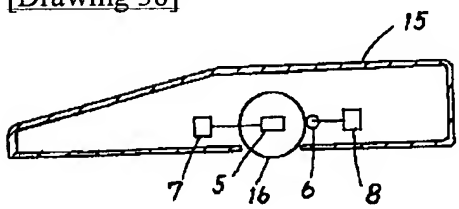




[Drawing 37]

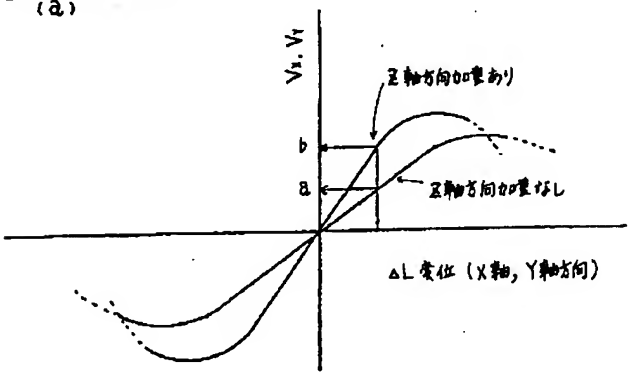


[Drawing 38]

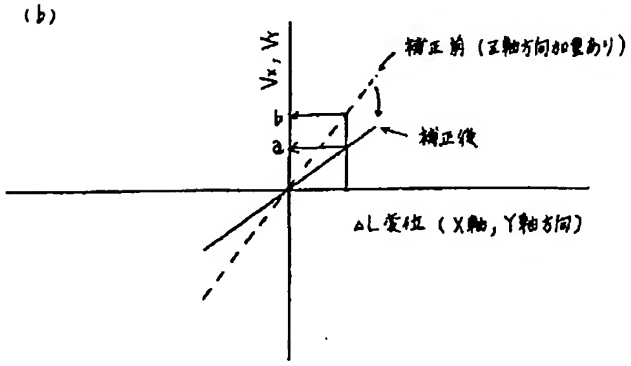


[Drawing 34]

(a)



(b)



[Translation done.]